CHAPTER 1

General introduction and outline

Osteoarthritis

Osteoarthritis (OA) is an age-related, chronic and progressive joint condition, and one of the most common joint disorders worldwide.[1] Although OA may affect any joint of the body, it is frequently seen in the hip joint,[2] causing pain, stiffness, instability, swelling, muscle weakness, disability, loss of function, and reduced quality of life.[2-4] Major risk factors for developing OA are older age and female gender.[2] Obesity, previous joint injury, muscle weakness, and genetics are also identified as risk factors for developing OA.[5] The two main categories are primary hip OA (idiopathic) and secondary hip OA (resulting from a known cause).[6]

So far there is no cure for OA.[7,8] Treatment of OA may be pharmacological, non-pharmacological or surgical, with total hip arthroplasty (THA) being the most frequently performed surgical procedure for end-stage hip OA.[5] Because of an aging population and the increasing prevalence of obesity, the incidence of hip OA in the Western world is on the rise, resulting in a higher demand for THA.[4,5]

Total hip arthroplasty

THA is considered one of the most successful, clinically effective, and cost-effective surgical treatments available.[9] In 2018 a total of 31,599 primary THAs were performed in the Netherlands[10] and 239,204 in Germany.[11] To improve function and reduce pain, the acetabular cup, femoral head, and femoral neck are replaced by artificial components. During the procedure the joint can be approached via different incisions and is then dislocated in order to extract the femoral head from the acetabulum.[12] The socket is prepared for placement of the acetabular cup prosthesis by using a reamer to shape the socket. The prosthetic components can be cemented, or porous material can be used to allow bone ingrowth by means of fixation. A liner made of ceramic or polyethylene is placed inside the cup. The femur is prepared for the prosthesis and a metal shaft will be inserted into the femoral stem. After attaching a temporary prosthetic femoral head the smooth and friction-free movement of the hip joint is tested. The final femoral head prosthesis is subsequently placed and checked for signs of friction, proneness to dislocation, and difference in leg length.[13]

Rehabilitation after THA

So far, consensus on rehabilitation following THA is lacking for type and timing of physiotherapeutic exercise, so there is heterogeneity in postoperative rehabilitation policies.[14] This can be illustrated with two neighboring countries, the Netherlands and Germany, as the Dutch and German healthcare systems have a divergent vision and policy with respect to THA and postoperative rehabilitation.

THA in the Netherlands

In the Netherlands, the vast majority of THA patients undergo fast-track surgery and are discharged into their home environment within 2-3 days. Fast-track surgery is a growing trend in Western countries and is the result of the increasing number of THAs that have to be performed and the expanding waiting lists. Benefits of fast-track surgery are shorter waiting lists and assumed financial hospital savings.[15] The disadvantage of a short hospital stay is that patients are limited in the support of their initial rehabilitation process and become more responsible for their own rehabilitation. Moreover, the success of a THA depends not only on an effective surgical procedure but also on adequate rehabilitation after surgery. And yet, as postoperative physiotherapy is essentially not covered by Dutch basic health insurance,[16] patients need an additional insurance package if they want reimbursement for physiotherapy sessions. In 2018, 83.6% of the Dutch adult population had additional health insurance.[17] Physiotherapy is one of the most-chosen additional packages, yet the number of treatments reimbursed by health insurers varies considerably – from 6 to 42 sessions per year.[18] It is therefore difficult to get a good impression of how much physiotherapy patients receive in practice. According to results published by Peter et al. (2016), there is considerable variation in the provision of postoperative physiotherapy in the Netherlands.[19] These authors mention that 92.7% of THA patients had postoperative physiotherapy in a primary care practice or at home. Of these patients, 58.3% had physiotherapy twice a week, the other patients once a week. The response rate in this study was 52%, so we don't know if these numbers are a valid representation. Both the *Dutch Orthopaedic Association* (NOV) and the *Royal Dutch Society for Physical Therapy* (KNGF) do recommend continuing physiotherapeutic exercise in an extramural setting after hospital discharge to improve existing disorders in functions like muscle strength, mobility, stability, and gait pattern, and to improve limitations in daily activities (for example performing transfers and walking).[20,21] As reimbursement depends on patients' individual insurance situation, there can be a large variation in the number of postoperative physiotherapy sessions they have.

THA in Germany

In Germany, the majority of THA patients stay in the hospital for approximately 10 days after THA.[22] Depending on several factors such as hospital policy and patient health status, surgery will follow the principles of either fast-track surgery or conventional surgery, so patients are discharged approximately four days (fast-track) or approximately 12 days (conventional) after THA surgery. During their hospital stay, patients receive physiotherapy on a daily basis. A 3-week rehabilitation period in a specialized rehabilitation center follows directly after discharge from the hospital. Such rehabilitation is aimed at reducing OA-related symptoms like chronic/non-chronic pain and dysfunction as well as preserving and/or restoring quality of life. For elderly patients

with hip OA, this means preserving self-determined and independent living and social integration; for the younger, working-age population it means reintegration to family, daily, and working life. During rehabilitation a multi-professional treatment approach is applied, including but not limited to stabilization and strengthening of joint muscles, joint protection training, provision of aids, practice of replacement functions to cope with everyday life with disabilities, and nutritional counseling.[23-25] After discharge from the rehabilitation center, no limit is set for the number of physiotherapy sessions paid by the statutory health insurance (*gesetzliche Krankenversicherung*) in the first six months after THA surgery. Whether additional physiotherapy is prescribed will depend on the patient's health status and their general practitioner or registered orthopedic surgeon.

Home-based rehabilitation programs

A possible alternative to the Dutch and German rehabilitation policies could be a home-based rehabilitation program. Recent research by Austin et al. shows that physical exercise does not need to take place in a formal setting – a home-based program could work too.[26] They showed that a home-based rehabilitation program seems to be both safe and efficacious for a majority of patients undergoing THA.[26] A systematic review by Coulter et al. found that physical exercises after THA are similarly effective whether they are performed unsupervised at home or supervised in an outpatient setting.[27] Still, a home-based program allows starting immediately with the rehabilitation after surgery. Bandholm and Kehlet (2012) emphasize this urge for immediate and intensive postoperative physiotherapy in order to optimize recovery.[28]

Recent technological developments such as wearable sensors and tablet PC use with mobile internet connection look promising for e-health home-based programs.[29] They allow for remote coaching options. Remote coaching appears to be a good alternative to supervised physiotherapy in an outpatient setting.[29] It can therefore be hypothesized that an e-health home-based rehabilitation program delivered by means of videos on a tablet PC and remote coaching could be helpful in the further development of such programs for patients after THA.

Aim

The overall aim of this thesis is to study the effectiveness of postoperative rehabilitation by comparing different policies and a novel technological alternative. To this end, the first aim is to compare the clinical and cost effectiveness of the Dutch versus the German rehabilitation post-THA approach. The second aim is to investigate the feasibility and effectiveness of an e-health home-based rehabilitation program, which could be an alternative to formal physiotherapy.

Outline of the thesis

Chapter 2 reports the results of a systematic review on the therapeutic validity and effectiveness of physiotherapeutic exercise following THA for OA. It has been recommended that in addition to the potential effectiveness systematic reviews should explicitly examine the therapeutic validity of these interventions. Therapeutic validity is defined as the potential effectiveness of a specific intervention given to a potential target group of patients. The therapeutic validity of the physiotherapeutic exercise interventions was assessed using the *Consensus on Therapeutic Exercise Training* (CONTENT) scale. **Chapter 3** presents a protocol to investigate the clinical and cost effectiveness of rehabilitation after total hip arthroplasty, an observational study to compare usual care between the Netherlands and Germany. The results of this observational study are described in **Chapter 4**. **Chapter 5** describes the feasibility and patient experience of an e-health home-based rehabilitation program driven by a tablet PC application and remote coaching for patients after a total hip arthroplasty. If such a program proves to be feasible – and, more importantly, effective – it could be used as an alternative to formal physiotherapy. **Chapter 6** follows by describing the research into the effectiveness of the home-based rehabilitation program and compares it with usual care in the Netherlands. **Chapter 7** summarizes the findings of this thesis, general discussion, and closing remarks.

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